How the Low-Voltage Directive Addresses Product Safety

Many questions have arisen regarding the Low Voltage Directive, its Product Safety Requirements and the CE MARK. What do they mean to a manufacturer of electrical and electronic products and what is necessary to comply?

The Low Voltage Directive

The Low Voltage Directive (LVD) 73/23/EEC is a council directive dated February, 1973 which was adopted to provide a single set of requirements and a single approval for many countries in the European Community (EC). Article 2 of The Low Voltage Directive states the following; "The Member States shall take all appropriate measures to ensure that electrical equipment may be placed on the market only if, having been constructed with good engineering practices in safety matters in force in the Community, it does not endanger the safety of persons, domestic animals or property when properly installed and maintained and used in applications for which it was made."

The directive also indicates that harmonized product safety standards are to be drawn up by common agreement between the bodies notified by the Member States and shall be kept up to date in the light of technological progress and the development of good engineering practice in safety matters. Any electrical products designed for use with a voltage rating of between 50 and 1000 volts for alternating current and between 75 and 1500 volts for direct current must comply with these unified standards if the products are to be marketed in the EC after January 1, 1997. The following equipment is exempt to this directive.

- Electrical equipment for use in an explosive atmosphere.
- Electrical equipment for radiology and medical purposes.
- Electrical parts for goods and passenger lifts.
- Electrical meters.
- Plugs and sockets outlets for domestic use.
- Electric fence controllers.
- Radio-electrical interference.
- Specialized electrical equipment, for use on ships, aircraft or railways, which comply with the safety provisions drawn up by international bodies in which the Member States participate.

Prior to the LVD a company who desired to sell electrical products into the United Kingdom had to have their products approved by the government approved agency, the British Standards Institute (BSI). If they wished to market the same products in Germany

they had to be constructed and approved under (VDE) or (TÜV) safety standards established by the Association of German Electrical Engineers. These safety agency standards differed from one country to another and their test methods also differed. This further complicated the safety approval process since one agency would not recognize the test data from the other. Under the LVD there are now **Harmonized Safety Standards** which provide the electrical manufacturer with one certification to comply with and is recognized amongst all members of the EC. This achieves one of the goals of the EC, which was to provide a standardized means of allowing commerce between member countries.

However, the LVD is not one all encompassing standard which covers all electrical products. The harmonized product safety standards of the LVD are typically selected from the International Electrotechnical Commission (IEC) or the regional body CENELEC European Norm (EN) standards. Like Underwriters Laboratories (UL) in the United States these standards cover product safety as it relates to the operator and the user. These safety standards help ensure that products are constructed following good engineering practices and that appropriate tests are performed on the product certifying that the above safety requirements have been met. A Technical Construction File must also be maintained on the product, which contains applicable test and technical data on the product's conformance. If these requirements are met, the manufacturer may then prepare a Declaration of Conformity. The Declaration of Conformity must then accompany each shipment the manufacturer makes. This becomes the signal to the receiving country that the products have met the requirements of the LVD and may then have the CE MARK applied to them.

What are the product safety requirements?

Since the product safety requirements differ from one specification to another, lets examine one specific product such as a Computer Monitor to identify some of the typical tests and how they are performed.

The Computer Monitor would first have to be designed and tested in accordance to the European Norm Standard **EN 60950 Standard; Safety Of Information Technology Equipment Including Electrical Business Equipment**. The products must be designed and constructed so that under all conditions of normal use and under likely fault conditions, it protects the user from electrical shock and against serious injury from fire originating in the equipment.

Where safety is involved components and sub-assemblies chosen for use within the product must comply with the safety aspects of the relevant IEC or EN component standards. All components shall be checked for correct application and use in accordance with their ratings. They must be subjected to the applicable tests of this standard as a part of the equipment with the exception of those tests which are a part of the relevant IEC component standard. A component which is not certified for compliance with a relevant standard shall be checked for correct application and use at its specific rating.

The EN 60950 Standard specifies **Performance** or **Type** tests on a representative sample of the product to determine if the product as designed and manufactured can meet the requirements of the standard. All of the tests are designed to insure the safe operation of the product by a user.

The **Routine** or **Production** tests are defined in the **EN 50116 Standard; Information Technology Equipment, Routine Electrical Safety Testing In Production**. This standard defines the tests which must be performed on each individual device during or after manufacture to detect manufacturing failures or unacceptable tolerances in manufacturing and materials.

Following are the three most common electrical safety tests which are specified under EN 60950. The Ground Bond and Dielectric Withstand tests are required as routine production line tests under EN 50116.

1. Provisions for protective earthing (Ground Bond test)

The purpose of this test is to check that the resistance between accessible parts required to be reliably grounded (earthed) for safety reasons and the protective earthing terminal or earthing contact is not higher than 0.1 ohms. A properly earthed product provides a necessary level of protection for the user in case the first protection level, the insulation, should fail. The test current should be 1.5 times the current capacity of any hazardous voltage circuit at the point where failure of basic insulation would make the earthed part live. The test voltage must not exceed 12 volts and the test current can be either AC or DC but should not exceed 25 amps.

The voltage drop between the protective earth terminals or earth contact and the part to be earthed are measured and the resistance is calculated by measuring the voltage drop. The resistance of the protective earthing conductor of the power supply cord should not be included in the resistance measurement. This test is specified as both a type test and a routine production test which must be performed on every product. Figure 1 shows a diagram of how the test is performed.

2. Leakage current test

Figure 2 shows the test circuit for performing the earth leakage test on single phase product. The measuring instrument is switched in each position and readings are recorded for each position of all primary power switches controlling the input power to the device under test. Depending on the type of equipment being tested, maximum allowable leakage currents can range anywhere from as low as 0.25 mA for class II (double insulated) products or as high as 3.5 mA for stationary products permanently connected to a power source. Note the leakage current readings obtained during this test are primarily related to the design of the instrument, this test is not required as a routine production line test under the EN 50116 specification.

3. The Dielectric strength test

This test is commonly referred to as a Hipot or Dielectric Withstand test, it is designed to test the electric strength of the insulating materials used within the product being tested. The test is performed by applying a sinusoidal AC voltage of at least 1000 volts for basic or operational insulation or 3000 volts for reinforced insulation at a frequency of 50 or 60 Hz. The specification also allows a DC voltage equal to the peak of the prescribed AC test voltage to be used.

The Type or Performance test specified in EN 60590 requires that the voltage be gradually raised from zero to the prescribed test voltage and held their for 60 seconds. There cannot be any indication of breakdown during this test. EN 60590 gives the following definition for Insulation Breakdown.

Insulation breakdown is considered to have occurred when the current that flows as a result of the application of the test voltage rapidly increases in an uncontrolled manner and the insulation does not restrict the flow of the current. Corona or single momentary flashover is not regarded as insulation breakdown.

For Routine or production line tests the test voltage must be applied between the primary and accessible conductive parts, excluding secondary circuits and must be maintained for at least 1 second but not more than 6 seconds. The potential must be at least 1500 volts AC for basic insulation and 3000 volts for reinforced insulation. Basic insulation is defined by IEC as the insulation that provides basic protection against electrical shock. Reinforced insulation is defined as a single system that provides a degree of protection against electrical shock equivalent to double insulation.

Insulation Breakdown for the production test is described as any significant increase from the steady state current measured during the test. The hipot tester must be provided with a means of indicating the test voltage and the insulation breakdown either with an audible or visual indicator. The trip current level shall be determined by the manufacturer of the product under test.

Under EN 50116 the manufacturer is obligated to maintain a file with the following data for every piece of equipment tested once a product conforms to the safety requirements of the LVD.

- Date of the test
- Model and serial number of the equipment
- Value of ground (earthing) circuit resistance with the corresponding current value
- Value of the voltage applied during the Dielectric Withstand test
- Quick reference information that the whole set of tests has or has not been successful.

The requirement for recording test data has made safety testing instruments with computer interfaces very popular. By using a PC to control the safety tester all test data can be automatically stored in electronic format at the end of every test.

The CE Mark

After a manufacturer has performed the required tests they can apply the CE MARK to the product and to the packaging but what does this mean? The CE MARKING on a product is the manufacturer or importer's self-declaration mark of conformity, declaring compliance with all applicable directives (Safety, EMC, amongst others). Products, which comply with all the relevant directives, can bear the CE Marking. The deadline for compliance to the EMC directive was January 1, 1996; the deadline for compliance to the LVD was January 1,1997.

Conclusion

Harmonization of standards can be a benefit to electrical manufacturers by providing them with a clear understanding of what tests must be performed. Customers that these manufacturers sell their products to can now have the assurance of knowing that products they purchase have been tested to conform to specified safety requirements. With a clear set of global standards to follow, manufacturers of safety testing instruments have responded by developing test systems that are safe and easy to use because they can perform these common tests with a single connection to the product under test and provide automatic storage of test data on each product tested.

Written by: DWAYNE M. DAVIS

About the Author

Dwayne M. Davis
Technical Services Manager at Associated Research, Inc. Mr. Davis holds an Electronics degree from DeVry Technical Institute. For over 20 years Dwayne has been instrumental in the design, development and manufacture of many of Associated Research's high voltage products including transformers, high voltage supplies and safety testing instruments. In addition, Dwayne has extensive field experience having done customer seminars throughout the world as well as presentations at industry gatherings. He is a recognized expert in the field of High Voltage Testing and its application. Today, Dwayne heads up the Technical Support group at Associated Research, Inc.